Technical Notes ON BRICK & TILE CONSTRUCTION

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REINFORCED BRICK MASONRY INSPECTORS' GUIDE — I

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INSPECTION

The masonry inspector's job is to obtain good masonry according to plans and specifications. The inspector, in addition, should explain the reasons for the specified procedure or technique of construction. Sincere mechanics will produce better masonry if they understand the reasons for certain procedures. Sincerity is not enough by itself, as can be seen by jobs where the quality of work was partially ruined by mechanics who laid header courses in the wall, or poured grout too stiff, all in the name of a "better job". Masons have remarked that they want to do as good a job as they know how, but they might cut protruding bed joint fins of mortar from the wall into the grout core or delay the puddling of the grout (these are discussed later in the text) because they do not understand that these techniques are detrimental to good results.

Fig. 1

Reinforced brick column.

Experience has shown that the following instructions are necessary to span the gap between research and field operations. Good masonry will be obtained if the requirements relating to the following are observed:

Construction Joints
Wetted Brick
Racking, Toothing and Wall Intersections
Mortar and Joints
Grout Handling
Grout Ingredients
Test Specimens

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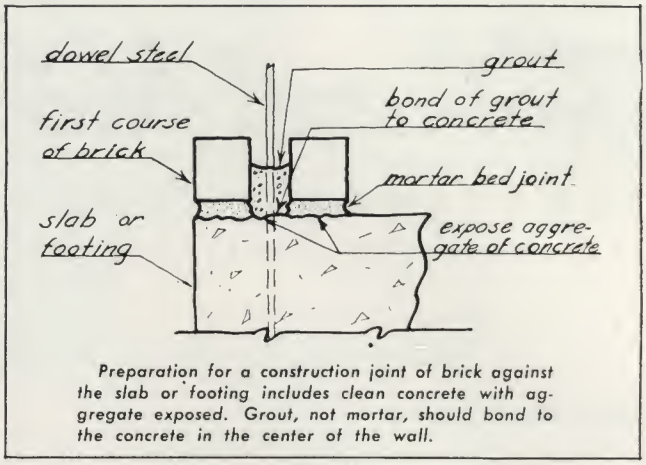
CONSTRUCTION JOINTS

A "cold" joint between brick and concrete must have the same consideration as a "cold" joint in concrete. Horizontal concrete surfaces that are to receive masonry must have the laitance completely removed and the aggregate exposed. The reinforcing dowels in the concrete must be placed in line so that they center on the grout space above. Before masonry work begins, concrete surfaces must be thoroughly cleaned and saturated with water. When laying up the wall, one course of brick only in the interior and exterior tiers shall be laid, making sure that no bed joint mortar spills onto the concrete in line with the dowels in the grout space. The grout is then poured to the middle of the brick, no higher, and then puddled in place. This assures a good bond between grout and concrete.

Fig. 2 shows a recommended construction joint.



Preparation for a construction joint of brick against the slab or footing includes clean concrete with aggregate exposed. Grout, not mortar, should bond to the concrete in the center of the wall.

Fig. 2

Recommended joint construction.

WETTED BRICK

Brick must be thoroughly wetted when laid, but must not have any surface water that stands in place. Surface water will make the brick float, a condition immediately recognized by the bricklayer. Usually the only time that brick will be too wet will be when they have been left overnight in the rain. *Exception:* Low absorption brick, 5 to 7 per cent total absorption (5 hr. boil) usually have the correct absorption rate when dry, and therefore should not be wetted.

The quantity of water in the brick is important because it controls the rate at which the brick absorbs the water from the mortar or grout. Research on both plain masonry and reinforced masonry has shown that a maximum bond is obtained with low absorption rate (a different item from total absorption). This rate of absorption is dependent upon the characteristics of the brick used, and involves mostly the brick porosity. The extreme limits of unsatisfactory bond between brick and the mortar (or grout) are when high absorption brick are completely dry or when the brick are 100 per cent wet.

In the first instance, the rate of absorption is too rapid, causing the mortar (or grout) to be sucked dry and to lose most of its bonding properties; in the second, the rate of absorption is too low, resulting in no suction; in field terms, the brick "float". There is a point somewhere between these limits of wetting where the maximum bond is obtained. In the laboratory, this point has been found to be not more than 20 grams (approximately .7 oz.) per minute for 30 sq. in. of brick surface immersed in $\frac{1}{8}$ in. of water.

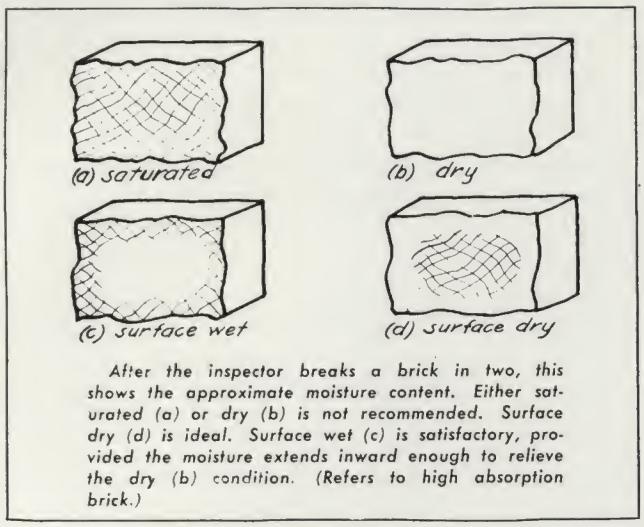
Fig. 3 shows what the inspector can expect to see after breaking a brick in two and observing the core. The ideal situation is where the brick have been saturated but are surface dry (Fig. 3d).

The surface wet condition (Fig. 3c) can also be satisfactory, depending upon depth of moisture penetration. Dry brick which have been lightly hosed down on the scaffold will be in the surface wet condition to a depth of approximately $\frac{1}{8}$ in. If the brick are not wet enough, this will be seen quickly when the brick are broken. The surface wet condition is probably quite satisfactory if the wetness extends to $\frac{3}{4}$ in. or more inside the surface.

The dry condition (Fig. 3b) is not satisfactory except for dense brick, such as non-absorptive facing brick. The dry condition is not acceptable for a building brick, especially with a high cement mortar such as 1C:$\frac{1}{4}$L:3S. This is particularly true in dry, hot weather.

The saturated condition (Fig. 3a) rarely occurs on the average construction job, except during rain. Practically, the inspector can usually forget about this condition, because, if the brick are saturated, the bricklayers will voice objection quickly to the superintendent or foreman. This complaint is a legitimate one, and the brick will be said to "float".

When the interior and exterior wythes of brick have widely different absorption rates, such as with an extremely dense and hard-burned facing brick backed up with a relatively porous building brick, it is important to maintain the correct water content in the two types of brick. The backup in this case should be soaked considerably longer than the facing units.



After the inspector breaks a brick in two, this shows the approximate moisture content. Either saturated (a) or dry (b) is not recommended. Surface dry (d) is ideal. Surface wet (c) is satisfactory, provided the moisture extends inward enough to relieve the dry (b) condition. (Refers to high absorption brick.)

Fig. 3

Moisture content of brick.

Wetting Techniques. Before starting the masonry work, the inspector should consult the project architect or engineer to determine acceptable wetting techniques. Brick must be wet with clean water, not with water from a dirty bucket or a bucket that might be used alternately for grout. A standard method used in wetting brick is to let a hose run on the pile or pallet of brick the day before using, or to place a bucket with small holes punched in the bottom on top of the pallet or pile and to allow a hose to run into the bucket. This causes the water to dribble slowly throughout the center of the pallet and to be more equally distributed over the brick. The hodcarrier can easily keep the bucket full and hose down the outside of the pallet periodically. Another method is to immerse the entire pallet in a tank of water for a specified length of time. This procedure, more costly than the others, has merit on hot days when other methods fail.

For MW type brick (ASTM designation C62-), good procedure is to saturate the brick thoroughly the day before use, using any of the above methods. When used the following day, the brick are surface dry and wet inside. Additional wetting may be necessary just before use, particularly in hot summer weather. To determine this, break a brick and if the wet core is the size of a quarter or dime, too much time has elasped between wetting and laying. If the core is dry and the perimeter is wet—the reverse situation—the brick were probably merely wetted down lightly before using or otherwise improperly wetted. The moisture in the heart of the brick prevents too rapid absorption of water from the grout and especially the mortar.

Although "total absorption" and "rate of absorption" are not the same, the inspector should note the absorption indicated on the Laboratory Brick Test Report or furnished by the manufacturer. Under normal weather conditions, it is difficult to oversaturate when brick absorption is 18 per cent or more. Actually, the reverse is more usually the case where brick having 18 per cent absorption were properly wet the day before use but dried out during the warm night and noonday temperatures. The denser and more impervious brick, such as facing brick with absorptions of around 8 per cent, do not require the same amount of wetting as higher absorption brick.

Brick are often delivered to the job site on pallets which makes uniform wetting difficult. If absolutely necessary during hot weather, the pallets can be divided and then wetted to insure wetting the center. This must be done by the hodcarrier on the job site, since the palletizing of brick is an exact industrial operation that cannot be varied. Caution: Brick should not be laid if they have become wet to maximum saturation after a period of rainy weather. In this case, brick are difficult to lay, and may slip out of line and plumb in the wall.

Composite Walls. A type of wall construction that is becoming increasingly widespread is the load-bearing composite reinforced wall. Composite walls of glazed hollow structural units on one side and brick on the other, with grout and reinforcing steel in the center, have received sufficient approval from building jurisdictions to warrant their mention here. In these walls, all that is true of brick regarding moisture content, mortar and grout also holds true. Glazed structural units, due to their low rate of absorption, need not be wetted before laying. Wall ties, crossing the wall between brick and glazed structural units are not only unnecessary but may be detrimental to the shear strength of the wall in reinforced and grouted work.

RACKING, TOOTHING, WALL INTERSECTIONS

When walls are racked, as is commonly done at corners, the grouting procedure is the same as for walls. However, in order to dam the grout at the end of each course, a brick is laid across the grout space. This brick is removed after the grout has solidified, and may be reused as a dam for the next pour of grout on the next course.

As a general rule, toothing is not permitted, and most codes so state. This has always been true of good practice in unreinforced masonry. However, under special conditions of design when a RBM

wall is extended, racking may be permitted by the architect or structural engineer. This is because the only other alternative for extending a wall is to have a vertical joint.

Sometimes, for reasons of scaffolding or construction schedules, the only practical way to build a "T" intersection in a wall is to build up the through section first, then return and put in the part shown by the stem of the "T". This can sometimes be done efficiently and with great strength, but since it involves an amount of toothing it should be permitted only by the architect or structural engineer. Obviously, the method should be determined before the bricklayers reach the intersection.
